Urban Landcover Mapping to Aid Regional Assessments of Greenhouse Gases

Jet Propulsion Laboratory
California Institute of Technology

E. Natasha Stavros

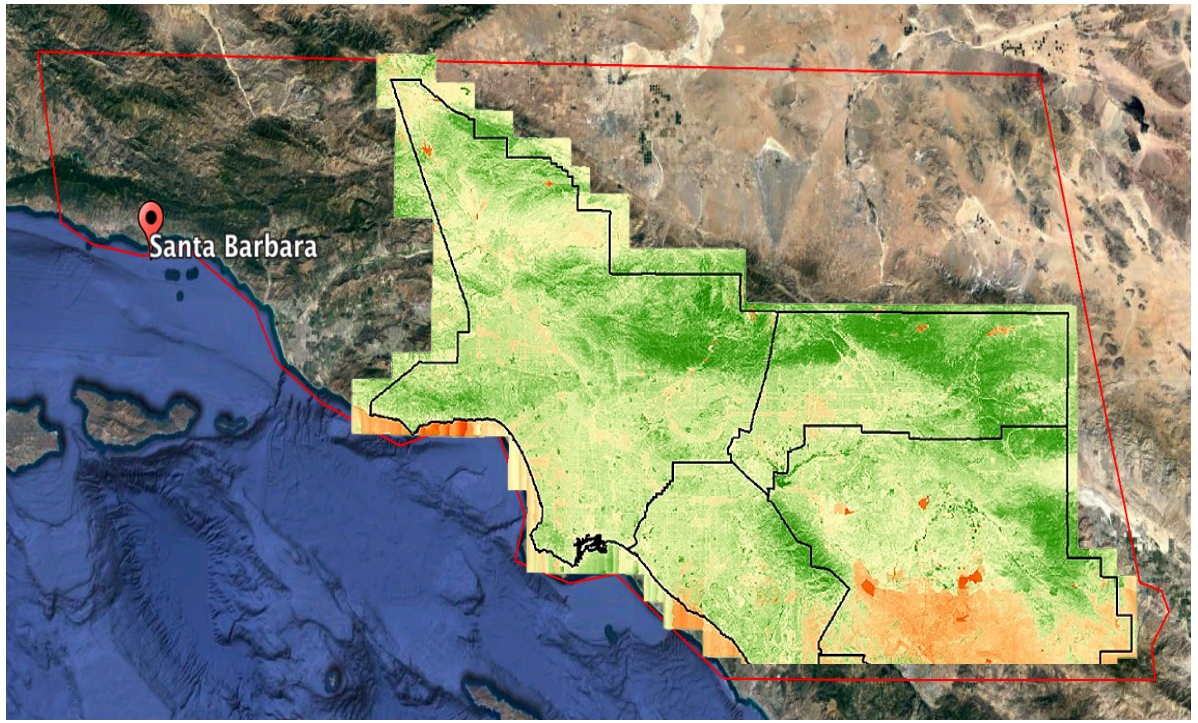
Willow Coleman, Kristal Verhulst, Nick Parazoo, Vineet Yadav

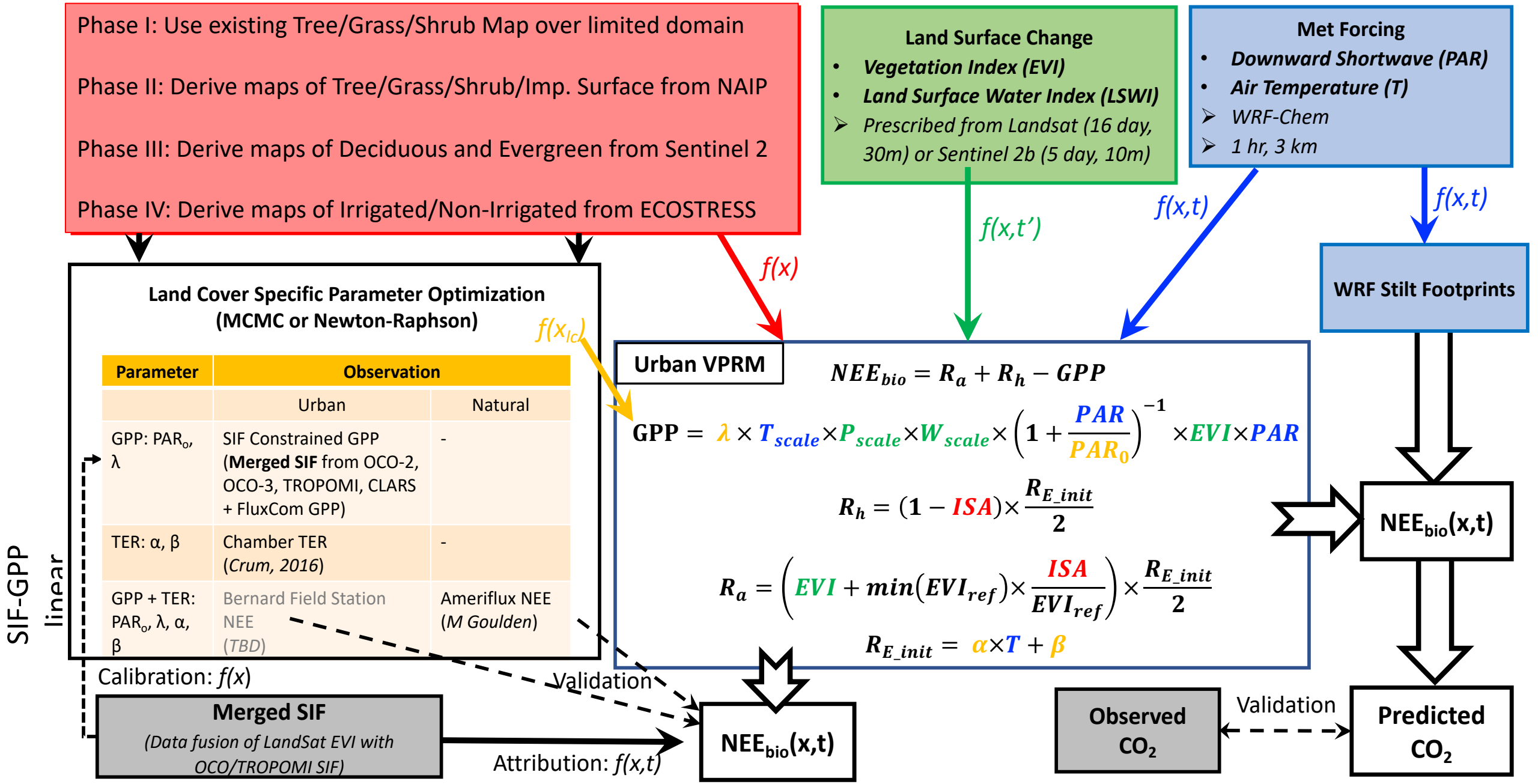
Jet Propulsion Laboratory, California Institute of Technology

February 19th, 2019

Background

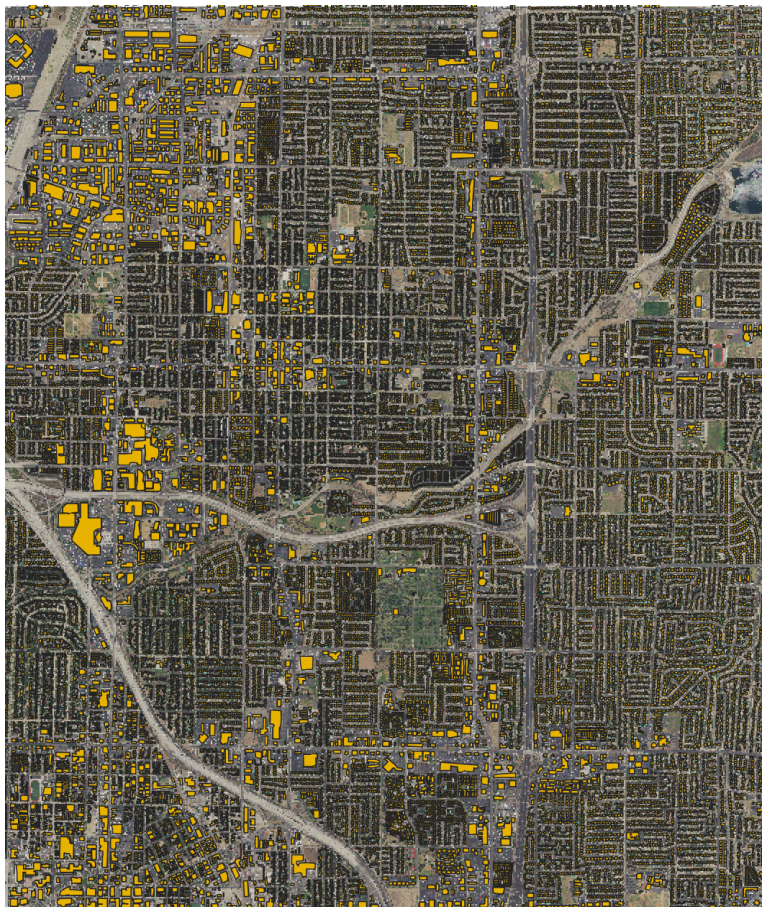
- Fossil fuel emissions of greenhouse gases from cities account for 70% of global anthropogenic emissions (Le Quere et al., 2013)
- Unknown influence of urban vegetation on city-scale attribution (Hutyra et al., 2014), but it could be up to 20% of total CO_2 flux (Miller et al., in prep)
- Current landcover maps either:
  - Do not cover the full extent needed to adequately parameterize regional flux inversion models, or
  - Are not at a fine enough spatial resolution



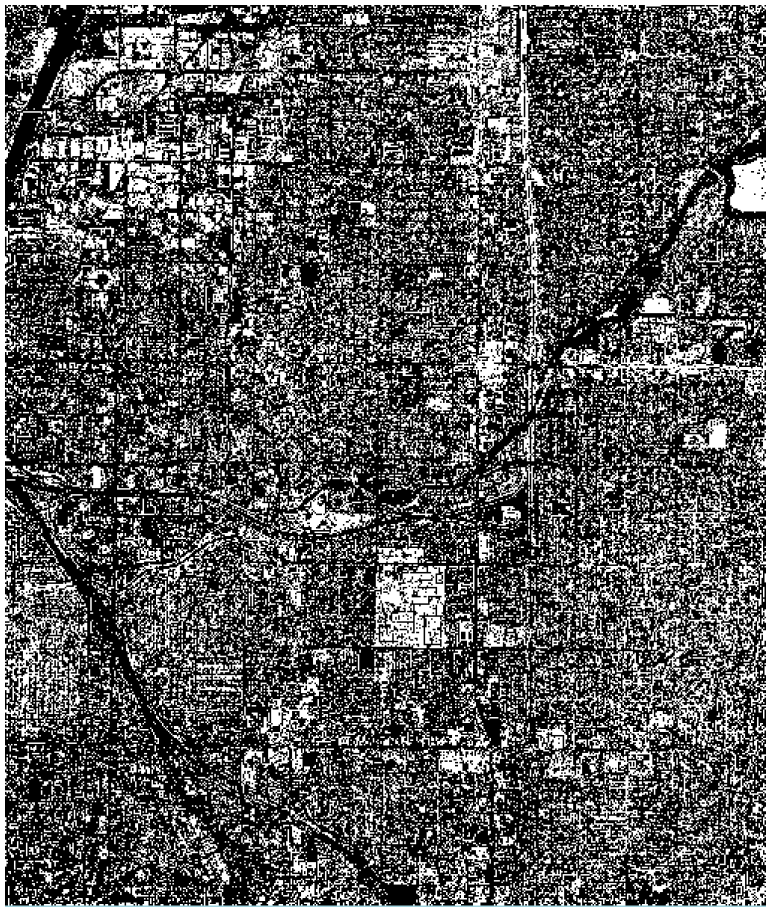

Phase I: Use existing Tree/Grass/Shrub Map over limited domain
Phase II: Derive maps of Tree/Grass/Shrub/Imp. Surface from NAIP
Phase III: Derive maps of Deciduous and Evergreen from Sentinel 2
Phase IV: Derive maps of Irrigated/Non-Irrigated from ECOSTRESS
Land Surface Change
Vegetation Index (EVI)
Land Surface Water Index (LSWI)
Prescribed from Landsat (16 day, 30m) or Sentinel 2b (5 day, 10m)
Met Forcing
Downward Shortwave (PAR)
Air Temperature (T)
WRF-Chem
1 hr, 3 km
f(x,t)
f(x,t')
f(x,t)
f(x)
WRF Stilt Footprints
Land Cover Specific Parameter Optimization
(MCMC or Newton-Raphson)
f(x_lc)
Parameter
Observation
Urban
Natural
GPP: PAR0, λ
SIF Constrained GPP (Merged SIF from OCO-2, OCO-3, TROPOMI, CLARS + FluxCom GPP)
-
TER: α, β
Chamber TER (Crum, 2016)
-
GPP + TER: PAR0, λ, α, β
Bernard Field Station NEE (TBD)
Ameriflux NEE (M Goulden)
SIF-GPP linear
Calibration: f(x)
Urban VPRM
$NEE_{bio} = R_a + R_h - GPP$
$GPP = \lambda \times T_{scale} \times P_{scale} \times W_{scale} \times \left(1 + \frac{PAR}{PAR_0}\right)^{-1} \times EVI \times PAR$
$R_h = (1 - ISA) \times \frac{R_{E\_init}}{2}$
$R_a = \left(EVI + min(EVI_{ref}) \times \frac{ISA}{EVI_{ref}}\right) \times \frac{R_{E\_init}}{2}$
$R_{E\_init} = \alpha \times T + \beta$
NEEbio(x,t)
Validation
Merged SIF
(Data fusion of LandSat EVI with OCO/TROPOMI SIF)
Attribution: f(x,t)
NEEbio(x,t)
Observed CO2
Validation
Predicted CO2

Example

2016 Leaf-On 1m NAIP Imagery

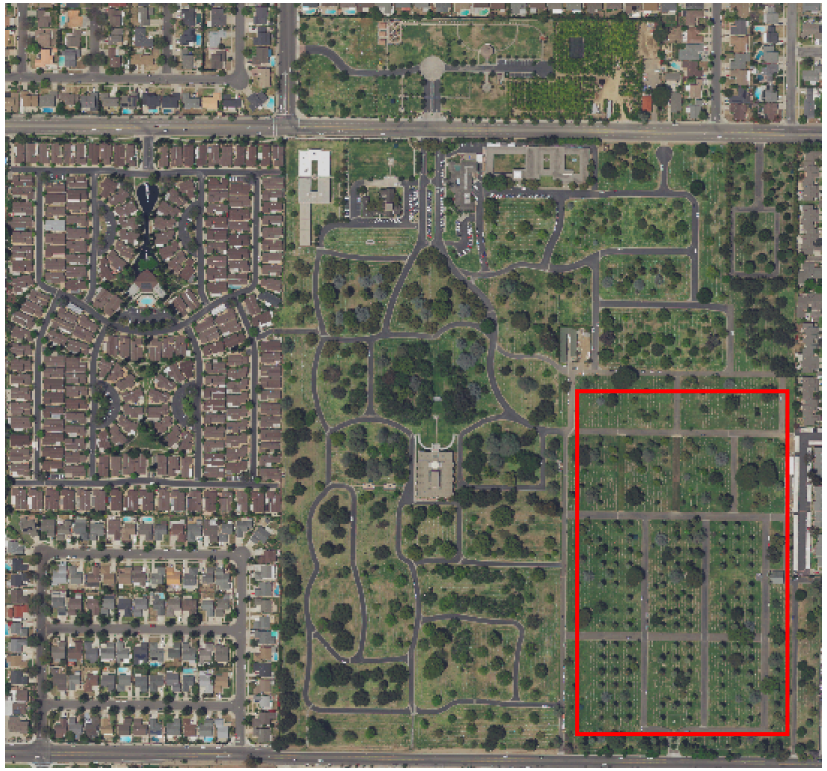


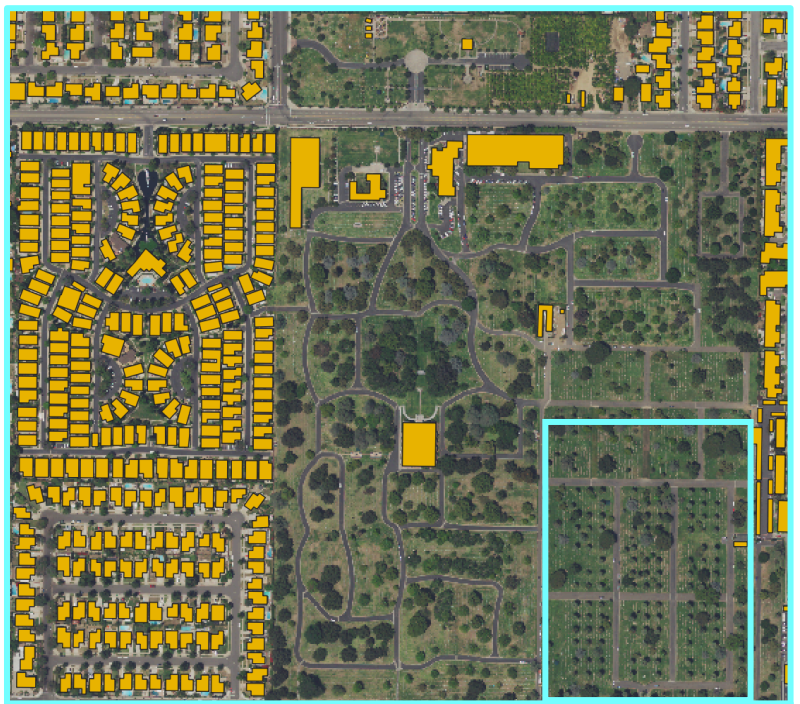
Building Footprints from Microsoft and Open Street Maps (Orange)

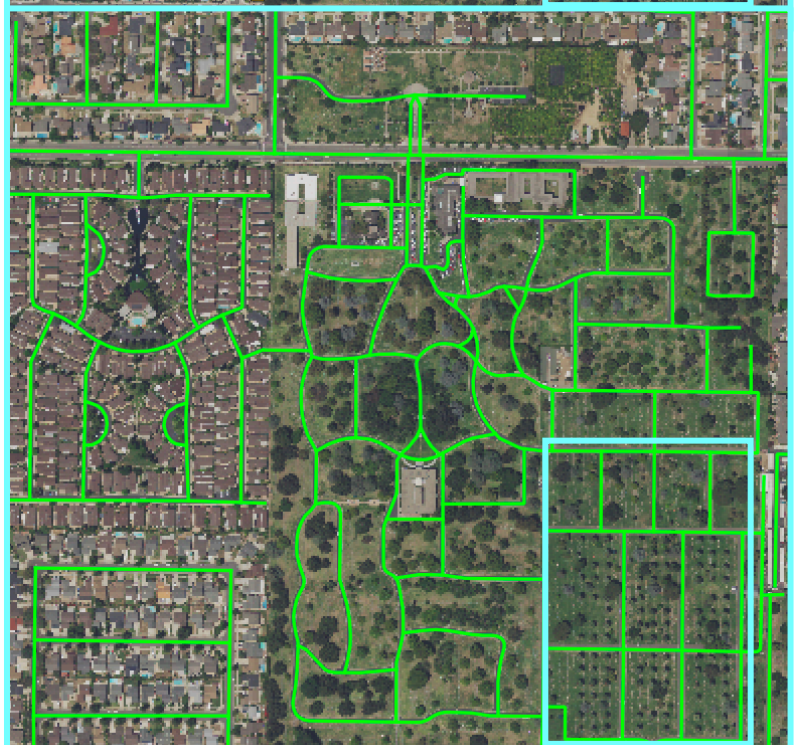


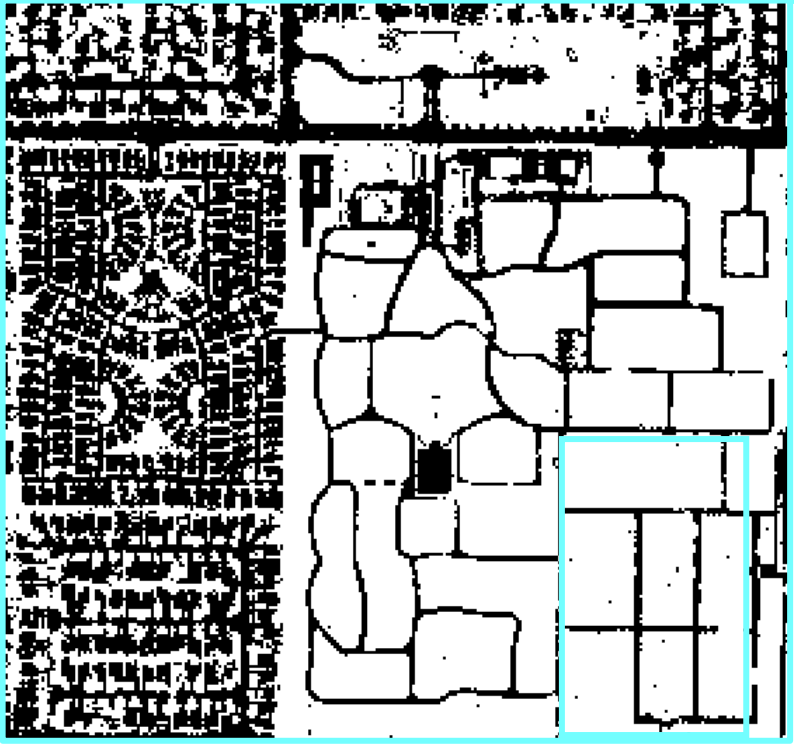
Initial Impervious Surface Mask
Black = impervious surface
White = other (vegetation, NPV, water, etc.)

Example Region of Interest (Santa Ana Cemetery)

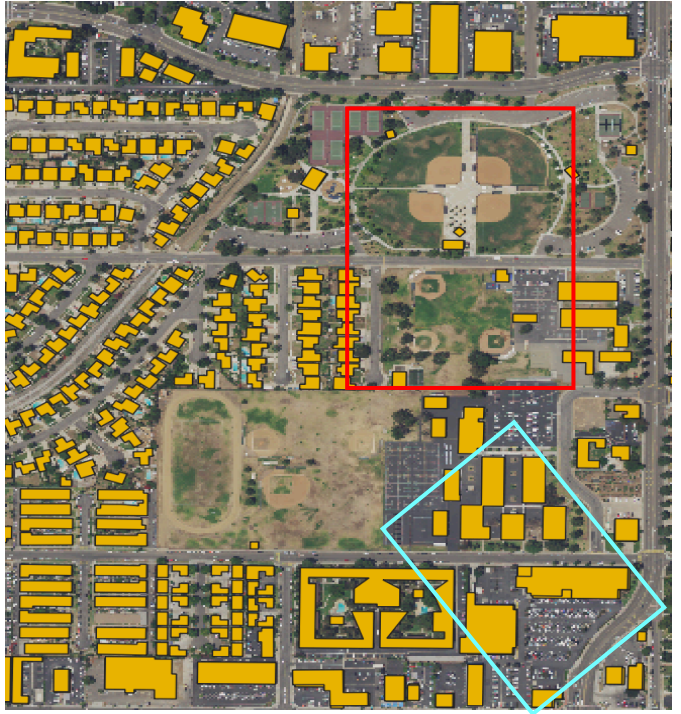


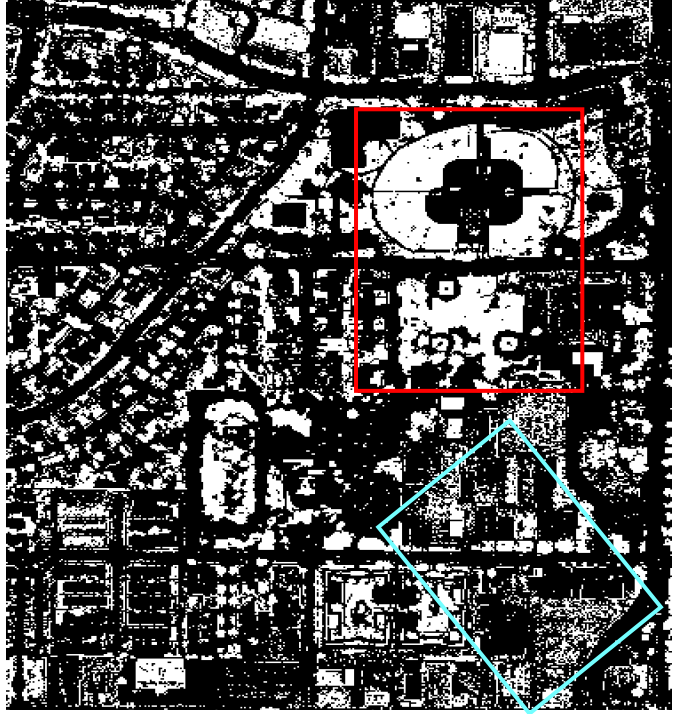


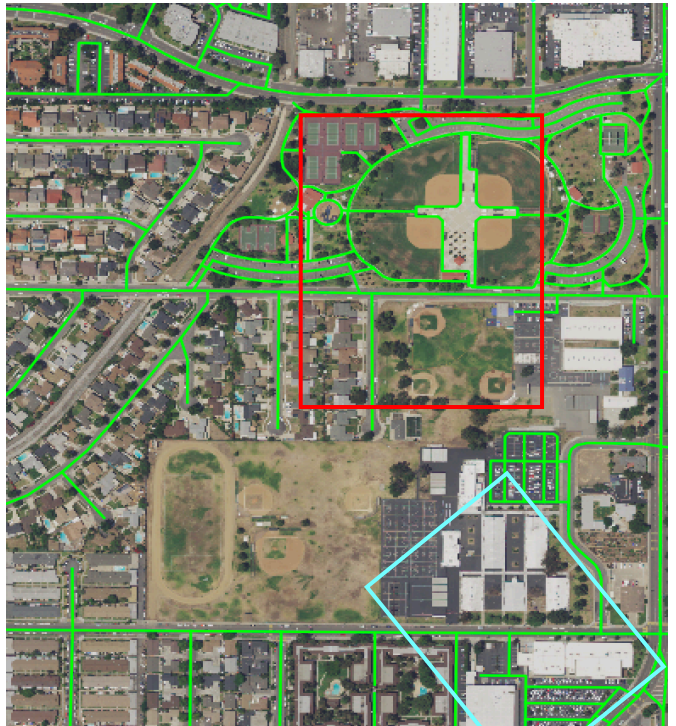


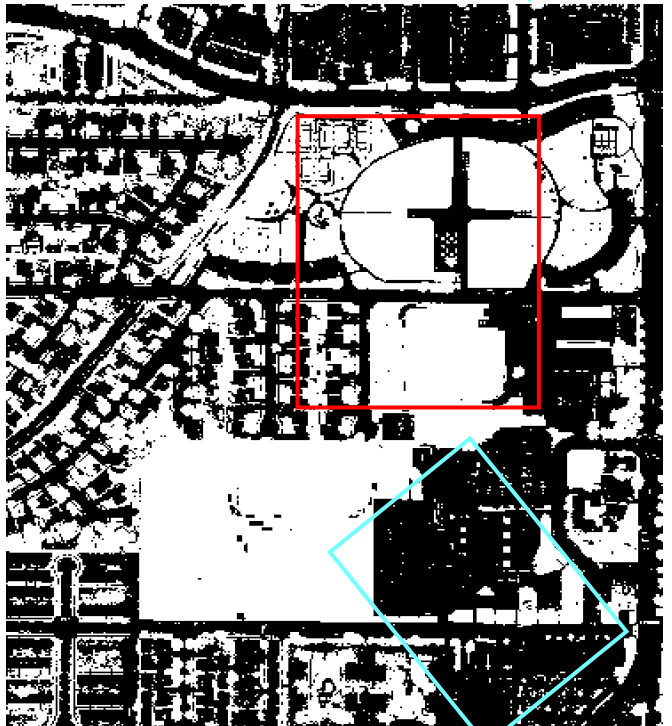


Region of Interest (Mixed Use Development in Orange, CA)









Statistics of Road and Roof: two box plots of NDVI, one for roads and one for roofs from the actual polygon and add text to plot that says the recall above each

- PLACE HOLDER

Potential Applications

- Energy sector greenhouse gas attribution
- Land Use Programs
  - Tree Planting
  - Grass Conversion